Ref #71

545.1

UNITED STATES DEPARTMENT OF AGRICULTURE

BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE

FOREST INSECT INVESTIGATIONS

TREE MEDICATION AS A CONTROL OF THE MOUNTAIN PINE BEETLE IN WESTERN WHITE PINE

1936 Injections

By
W. D. Bedard
Assistant Entomologist

Forest Insect Laboratory
Coeur d'Alene, Idaho
Nov. 17, 1936

U.S. GOVERNMENT PRINTING OFFICE 60918

TREE MEDICATION AS A CONTROL OF THE MOUNTAIN PINE BEETLE IN WESTERN WHITE PINE

1936 Injections

By
W. D. Bedard
Assistant Entomologist

Forest Insect Laboratory
Coeur d'Alene, Idaho
Nov. 17, 1936

INTRODUCTION

Experimental injections of poisonous solutions into western white pine trees infested with the mountain pine beetle (Dendroctonus monticolae Hopk.) have been undertaken annually for the past six years in an attempt to kill the broods of this insect. Accounts of these earlier studies have been given in the reports listed below so that a summary of this work need not be given. This report includes an account of the 1936 injections with a discussion of the merits and shortcomings of the various poisons and methods of injection used during these studies.

REFERENCES

1931 - St. George, R. A. and Gibson, A. L. Tree Injection Studies with Lodgepole Pine and Notes on Western White Pine. (Unpublished report)

1933 - Gibson, A. L. and Bedard, W. D. Tree Medication as a Control of the Mountain Pine Beetle in Western White Pine. (Unpublished report)

1934 - Bedard, W. D. Additional Information Concerning Tree Medication as a control of the Mountain Pine Beetle in Western White Pine. (Unpublished report)

1934 - Bedard, W. D. Tree Medication as a Control of the Mountain Pine Beetle in Western White Pine, 1934 Investigations. (Unpublished report)

1935 - Bedard, W. D. Results of the 1934 Tree Medication Experiments in Western White Pine. (Unpublished report)

1935 - Bedard, W. D. Tree Medication as a Control of the Mountain Pine Beetle in Western White Pine, 1935 Investigations (Unpublished report)

1936 - Bedard, W. D. Tree Medication as a Control of the Mountain Pine Beetle in Western White Pine. Results of 1935 Injections. (Unpublished report)

1936 PROJECT

The areas drained by Deception and Cascade Creeks on the Coeur d'Alene National Forest were selected for the 1936 injection work. It was found feasible to house the crew in a permanent building at the mouth of Deception Creek and work the two areas from this point. Treating was started on August 24th, and most of the time the crew was kept to eight men, comprising a six-man treating crew, a cook, and the writer, who was in charge of the project. In reality, however, the project was begun early in July when three experienced men were employed to cruise the areas periodically in order to tag and map the trees as they were attacked and thus have definite information as to the age of attack in each tree.

During the duration of the project a total of 156 trees were treated according to the following schedule of poisons, methods of injection, and ages of attack.

Age of attack in days	No. Trees Treated						
	$ZnCl_2$ Rubber collar	$ZnCl_2$ Rubber band	$ZnCl_2$ Paper collar	$ZnCl_2$ Painted tin	Cu SO_4 5 H_2O Rubber collar	N_aCNS	NH_4F Rubber collar
26-35	7	3	1	1	7	hack girdle 3 auger holes 3	6
36-45	7	3	1	1	7	rubber collar 2	
46-55	7	3		1	7	" " 1	2
56-65	7	3	1	1	7	" " 3	1
66-75	7	3	1	1	7		
76-85	7	3	1	1	7		2
86-95	7	3	1	1	7		

Insofar as possible tree diameters were kept equal in all groups. The average diameter for all trees was 19.4 inches, while the average diameter for each group is shown in the following table.

Poison and method of injection	$ZnCl_2$ Rubber collar	$ZnCl_2$ Rubber band	$ZnCl_2$ Paper collar	$ZnCl_2$ Painted tin	$CuSo_4$ Rubber collar	N_aCNS	NH_4F Rubber collar
No. of trees	49	21	7	7	49	12	11
Av. D.B.H.	19.7	19.2	19.4	19.9	19.8	18.6	19.9

The 1936 project was concerned with five problems: First, it aimed to test various poisons; second, it attempted to develop and test new methods of injection; third, it attempted to duplicate the results secured during 1935 with copper sulphate; fourth, it treated trees of which the date of attack was definitely determined; and fifth, it made an attempt at treating trees with a commercial wood-preservation dosage. Each of these five phases will be discussed in order.

Poisons Used During 1936

In all, only four poisons were used during this project. Of these copper sulphate ($CuSo_4$ 5 H_2O) had been tested and found very successful in 8-ounce doses during the 1935 project. In the powdered form this poison is easily handled, is readily soluble, and is not irritating to the handler unless the fine powder is inhaled in the nose, where it is caustic to the mucous membranes.

Zinc chloride ($ZnCl_2$) was used most abundantly during the 1936

project in an effort to secure a wood preservative not detrimental to metals which may later be used in the wood. This poison is readily soluble in very cold water; in fact it is deliquescent, which is inconvenient because it is necessary to transport the poison in airtight containers. In addition, zinc chloride is caustic to the skin, which necessitates wearing rubber gloves in handling it. It is approximately twice as expensive as copper sulphate. Comparing this poison with copper sulphate, it does not appear necessary to endure the disadvantages of the zinc chloride merely to find a poison which does not corrode metal in seasoned wood, because in the western white pine work it is felt that this factor is of no consequence. The impregnation of the outer inch or half-inch of sapwood is the object of our wood-preservation dosage, and approximately 90 percent of this wood is lost in slab when the log is sawed into lumber.

Upon the recommendation of Dr. Roark of the Insecticide Division, ammonium fluoride (NH_4F) was used in eleven trees. This is an excellent poison from the standpoint of handling and solubility; it is however almost twice as expensive as zinc chloride and almost four times as expensive as copper sulphate.

Upon the suggestion of Mr. Hoyt, arrangements were made for Mr. Offord of the Blister Rust to visit the project. He suggested the use of sodium thiocyanate (N_aCNS), which had been used successfully in eradication of ribes. This poison is readily soluble, but is however deliquescent, and in addition the poison handler must be very careful

not to inhale any of the material. In place of being a wood preservative it has quite the opposite effect, in that it aids the development of bacteria and probably wood-destroying fungi. No cost figures have been secured for this poison.

Technique of Injection

The original plan for this work called for the testing of two major methods of injection; one the rubber band method, and the other the collar method, in which an attempt was made to substitute some noncorrosive material for the tin collars ordinarily used on these projects. Basically, these two methods are similar in that both use a saw-kerf completely encircling the tree, through which the injected solution flows and by means of which the tree takes up the solution. In application, however, the methods are radically different.

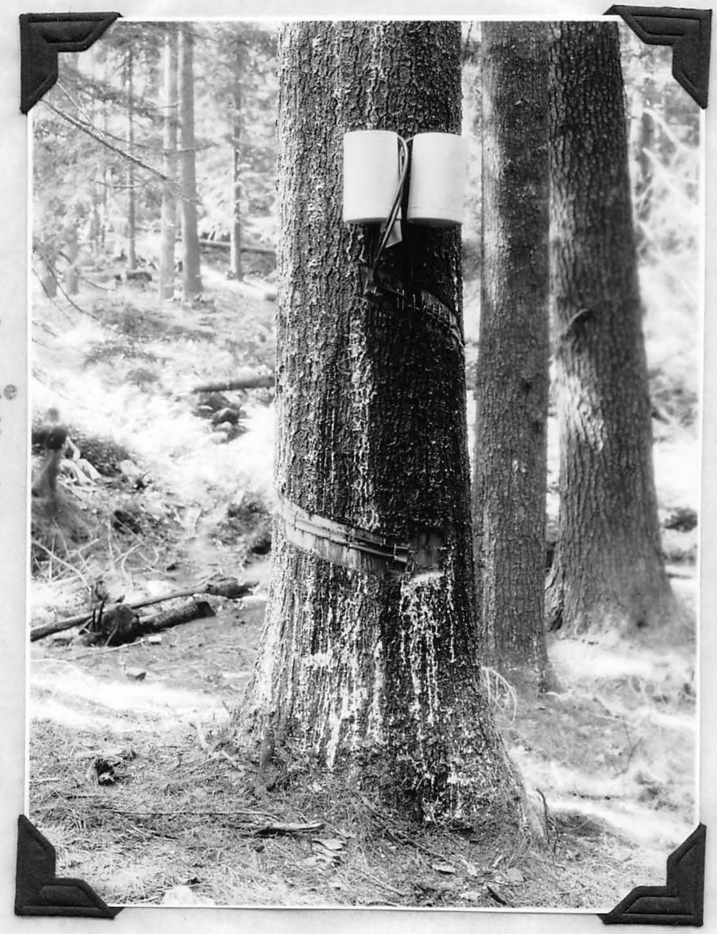
In the rubber band method the saw-kerf is made to spiral around the tree so that by injecting the solution at the upper end of

Fig. 1- Tree prepared for application of rubber band, showing spiral-cut, cleared-out saw-kerf to permit free passage of liquid, and removal of bark to permit tight application of rubber. (All photos by H. J. Rust)

the spiral it will flow down hill to the other end of the cut. Next, a narrow strip of bark is removed on either side of the kerf so that a tight application of the rubber band can be secured, and the saw-kerf is cleaned either with a timber scribe or wood chisel to insure free passage of the liquid. Holes are then bored through the wood into the saw-kerf, into which small copper tubes are inserted by means of which the solution is introduced into the kerf behind the rubber band. After the rubber band has been stretched and stapled in place as shown in figure 2, the poison solution is placed in gallon containers made of paper, fastened to the tree, the siphons made and siphon hoses connected with the copper tubes. The bottom end of the rubber was left unfastened until the solution flowed from the saw-kerf in order to be certain that the solution was flowing properly through the cut. Owing to the heavy dosages of poison which were being used, and the fact that only gallon containers could be secured, it was necessary to use two containers on most of the trees. These containers are termed "Master Cans" and are used in shipping ice cream and similar materials.

Fig. 2- Rubber band being stapled in place. One man stretches the rubber while the other drives the staples.

Fig. 3- Completion of rubber band treatment. Two paper gallon containers to hold the solution and siphons leading from containers to copper tubes inserted behind rubber band



In the collar method, the saw-kerf is kept as level as possible completely around the tree. A narrow strip of bark is then removed below the saw-kerf, and the rubber collar, tin collar, or paper collar is applied as shown in Figure 6. Both the rubber and paper require a narrow strip of tin held with shingle nails to hold the collar firmly against the tree. All three collar methods have their advantages and disadvantages. From the standpoint of cost, providing all types are equally effective, the paper collar has the advantage as shown in the following compilation:

Cost of Treating 20-inch Tree

	Painted tin collar		Rubber collar	Paper collar
Labor	$0.56		$0.466	$0.56
Collar	0.386	Approx.	0.30	0.12
Nails	0.02		0.02	0.02
Tin strips	---		0.027	0.027
	$0.966		$0.849	$0.727

The rubber collar is more quickly applied as shown in the labor cost per tree, which means simply that more rubber collars can be applied per treating man-day than tin or paper collars. The cost for each individual collar is not particularly accurate due to the fact that old, abandoned inner tubes were used during the 1936 work. An excellent rubber band for collar material was secured by Mr. R. A. St. George, but the cost is considered higher than it is felt can be afforded for control work. This rubber costs 14 cents per foot, which would make the cost of the rubber for a 20-inch tree 70 cents. A fairly cheap grade of rubberized sheeting suggested by Mr. J. C. Evenden was tested following the completion of the project and was found to be satisfactory in all respects. The retail cost of this sheeting is 8.7 cents per square foot, and it is believed that the

Fig. 4- Tree prepared for any type collar, showing horizontal saw-kerf at upper edge of peeled band and bark removed to insure tight application of collar.

wholesale price will be considerably cheaper. Considering the approximate wholesale price, the cost of the material for an average tree (20 inches d.b.h.) would be approximately 30 cents. This material has the advantages of lightness and cheapness, and is a standard product which can be secured without special order. The cost of the painted tin is fairly accurate except that the cost of painting the tin may be a trifle high.

Exclusive of cost, the rubber collar appears to be the most feasible of the three collars. It can be applied with no leaks whatsoever, and when no saw-kerf is made, will hold copper sulphate solution for weeks as shown by test. A good grade of mailing tag paper was used for the paper collars, and although successful when carefully applied, if a leak did occur, it was impossible to stop. It is felt that this type of collar is not sufficiently fool-proof for regular control crews. The tin collar, of course, has been shown

Fig. 5- First step in application of rubber collar.

to be successful in past control projects. With the change of poisons, however, and the necessity for asphalting the tin, the rubber collar is more to be desired.

The cost figures for comparing the rubber band with the rubber collar are shown in the following tabulation.

Cost of Treating 20-inch Tree

	Rubber band	Rubber collar	Cloth collar
Labor	$0.84	$0.466	$0.400
Band or Collar	0.34	0.70	Approx. 0.30
Staples or Nails	Approx. 0.02	0.02	0.02
Tin Strips	--	0.027	0.027
Two containers	0.24	--	--
Rubber tubing	0.18	--	--
Copper tubing	0.06	--	--
	$1.68	$1.213	$0.747

Fig. 6- Rubber collar is held in place with narrow strips of tin fastened with shingle nails.

Again it must be stated that some of these cost figures are only approximate, particularly because no cost figures were secured for staples in the banding experiments and because no wholesale price has been secured for the rubber sheeting. It will be noted that labor

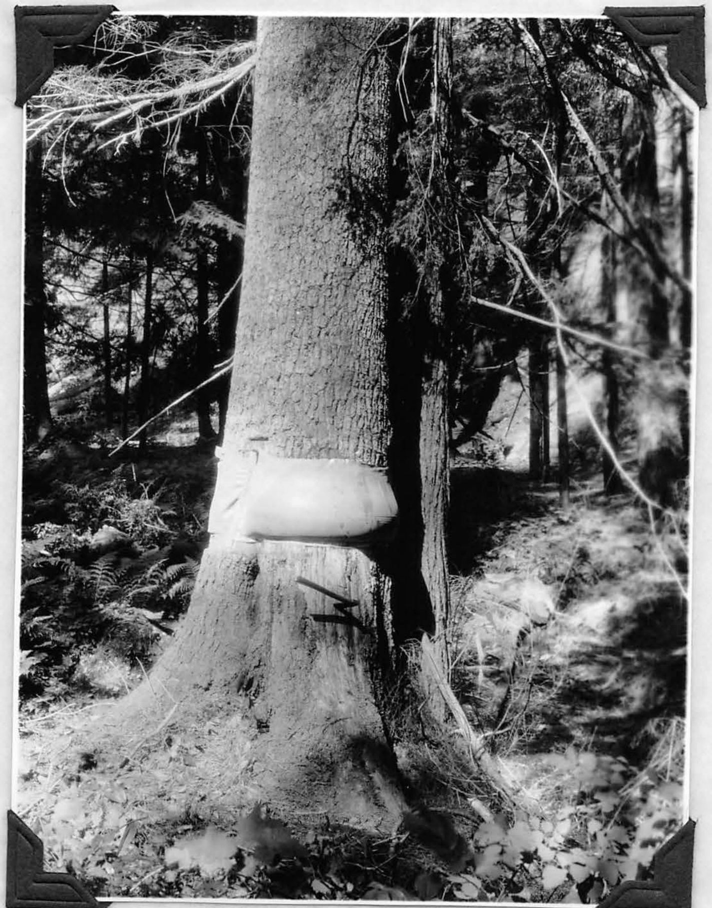


Fig. 7- Completed rubber collar on 38-inch white pine.

is considerably higher to treat with rubber band than with the rubber collar. In reality, there is not a sufficient spread even yet in this labor cost figure, because one crew can treat between two and three times as many trees with the rubber collar as with the rubber band.

The reason for this is quite obvious when the application of the two methods is considered. In preparing the tree for the rubber band, it is necessary to make three saw cuts: one deep one to introduce the liquid into the tree, and two shallow ones just through the bark--one above and one below the original cut to prevent the removal of too much bark from the tree. The rubber collar requires but two saw cuts. In the rubber band method, the saw cut must be cleaned with a timber scribe or wood chisel to allow for the free passage of the liquid. This is not necessary when using the rubber collar. Next, when applying the rubber band, it requires one man to stretch the rubber and one man to staple it in place. In applying the rubber collar, both men nail it in place at the same time. This is the only operation which requires more time for the rubber collar than for the rubber band, but this is offset

Fig. 8- Tree injected by means of tin collar which has been painted inside with asphalt paint.

somewhat by the fact that both men can nail on the collar while only one can staple on the rubber band. Following this operation, the collar application has been completed and the tree is ready for the poison. With the rubber band treatment, however, the applicator must yet bore holes through which the solution is introduced into the saw cut. This is done before the band is stapled on. In addition he must hang the containers on the tree, make the siphon, attach the siphon hoses to the copper spiles and wait until the solution has reached the lower end of the spiral to be certain of a successful application. Relative to the cost figures stated above, it should be stated that if the dosage per tree should be reduced, only one container, one siphon tube, and one copper fitting would be necessary for each rubber band tree, and this would reduce the cost 24 cents per tree, making a total of $1.44.

Fig. 9- Tree injected by means of paper collar. Tools used in collar treatment shown at base of tree: docking saw, peeling spud, tin strips, tin snips, hammer and rope used to mark level for saw-kerf.

In addition to the band and collar treatments three trees were treated by means of auger holes and three by means of hack girdle. These tests were made with sodium thiocyanate to ascertain the feasibility of treating trees dry with a deliquescent material and allowing the poison to provide its own moisture. In the hack girdle experiments the tree was merely hacked with an axe and the dry powder dusted into the axe cuts. In the auger hole tests tangential holes were bored completely around the tree at a slightly downward angle, and these holes were filled with the poison.

Duplication of 1935 Results

Very little can be said concerning this phase of the study until the trees have been examined during the spring of 1937. Owing to changes in poisons or methods of injection used each year, it has never been possible to duplicate successful results secured during previous seasons. Even this year, owing to the adoption of heavy dosages for tree preservation purposes, the 1935 work with copper sulphate has not been exactly duplicated. However, 49 trees were injected with this poison during the 1936 project.

Elapsed Time Between Attack and Injection

No question should arise this year relative to the accuracy of the date of attack recorded for each tree. On July 1st, one experienced man was placed in the area, and he marked out definite strip lines which were cruised weekly and each infested tree tagged and mapped as it occurred. Later in the same month two more experienced men were

sent out to assist him in this work. Thus all trees treated during the 1936 project were found within one week after attack.

Wood Preservation Dosages

During the 1936 project all trees were treated with what has been termed "the commercial wood preservation dosage". This consists of sufficient poison to impregnate each cubic foot of wood with one-half pound of the poison used. Owing to the large volume of wood in each tree it is not feasible to treat the entire tree in this manner, so that it was recommended to attempt to impregnate only a shell of wood surrounding the bole. The recommendation in western white pine was to consider only the outer half inch of wood to a height which included the last merchantable log. For this purpose the cubic contents of a half-inch shell of the necessary height and taper for the drainages to be treated was computed for each two-inch diameter class. According to this computation, the smallest tree treated during the project, a six-inch tree, required 1 1/2 pounds of poison; the largest tree, 38 inches in diameter, required 14 pounds; and the average tree required 6 pounds.

The practicability of commercial preservation dosages in western white pine medication work is open to question. In the first place it is extremely doubtful, judging from the distribution of copper sulphate in trees recently analyzed by Wilford, whether the minimum dosage will even approximate the desired impregnation. Even with the dosages used during the 1936 project, the work was badly handicapped because on many days the men were compelled to carry over 100 pounds

of poison besides the regular treating equipment and the necessary extra water. Any additional increase in dosages will necessitate more men merely to transport poison and water. Even if wood preservation were achieved, the monetary advantage of such achievement is dubious. This statement is made because, when white pine trees are treated in the fall, blue stain has already colored the sapwood in a high percentage of the trees. In addition, it has never been economically feasible for lumber companies to salvage "bug-killed" timber in western white pine, even when the company has been in operation in green timber in the salvage area. The poor grades of lumber which are cut from the stained trees make the cost of logging higher than the return on the lumber.

Cost of the 1936 Project

Cost figures are itemized under the following headings: labor, subsistence, transportation, materials and equipment. Expenditures under subsistence are as follows:

Cook's salary	$90.00
Food purchased	257.38
Total	$347.38

Expenditures under transportation are as follows:

Auto Freight hauling copper sulphate	$3.35
" " " paper cans	.35
G.B.L., NH_4F from Washington	3.86
G.B.L., $ZnCl_2$ " "	12.51
Repairs to truck	21.02
Tires for truck	50.00
Total	$91.09

Expenditures under materials and equipment are as follows:

Copper sulphate	$51.00
Zinc chloride	61.84
Ammonium fluoride	14.50
Paper cans	9.28
Rubber tubing	3.75
Rubber gloves	1.20
Nails, paint, kitchen ware	10.29
Paper collar material	2.25
Tin strips	5.50
Total	$159.61

The summary of expenditures on a per tree basis is shown in the following tabulation:

Summary of Expenditures on Tree Basis

	Total	Per Tree	Total	Per Tree
Spotting	$381.69	$2.446		
Treating	345.33	2.213		
Camp	67.20	.430		
All labor			$794.22	$5.090
Subsistence (Includes cook's salary)			347.38	2.226
Transportation			91.09	.583
Materials and equipment			159.61	1.023
Total			$1,392.30	$8.925

Appropriation	$1,500.00
Expenditures	1,392.30
Balance	$ 107.70

As would be expected on a purely experimental project, the cost per tree for the 1936 project is considerably higher than for any other previous tree medication project. This is accounted for by several factors. First, spotting costs were considerably higher due to the fact that three trained men spent approximately one month each in locating the trees in order to have the definite date of attack of each tree. In locating these trees no solid body of timber was surveyed, but strip lines were so placed as to cover desired areas in the most feasible manner. As a result of this

type of spotting, spotting costs were high and trees mapped for treatment were scattered. These scattered trees reduced the man-day production and thus greatly increased treating costs. Poison costs were considerably higher due to the fact that zinc chloride and ammonium fluoride were used. These heavier dosages also decreased the man-day production. When one considers the fact that trees treated per treating man-day was less than one-fourth the production on previous projects, the cost per tree would not be very high. It would be safe to state that in treating trees by tree injection, materials and labor would cost less than $1.00 per tree, while subsistence and transportation should not cost more than another dollar. In other words, on regular medication projects the cost per tree should not be more than $2.00 per tree.